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HEINRICHS' DYNAMO-ELECTRIC GENERATOR AND SYSTEM OF ELECTRIC LIGHTING.

THE discovery of the application of an annular armature for electric generators made by Dr. Antonio Paccinotti of Florence in 1860, and independently reinvented in a modified form by M. Gramme of Paris ten years later on, gave a great impulse to the general application of electricity for lighting purposes, transmission of motive power, electroplating, &c., &c. In consequence of this the minds of most of our electrical inventors have been led to modify the form of the ring armature so as to obtain from it better results in the production of electric currents. We have shown many forms of ring armature machines in our columns, but we find that but little credit has been accorded to Dr. Paccinotti for the originality of his invention, notwithstanding that a working model of small size of the Paccinotti Generator was made, and the same well described in *Il Nuovo Cimento*.* Many existing machines are merely modifications of the Paccinctti, as, for instance, the Gramme, the Hefner-Alteneck (Siemens), the Lontin (excitor), the Schuckert, the Brush, and the latest, that of Mr. C. F. Heinrichs, which, from the results obtained with the first generator made, seems to be one of the most efficient forms.

We described in November last the principles and forms of the different ring armatures, also the methods of winding the insulated conducting wires thereon, and also the form and position of the inducing magnets. We showed, by comparing the Heinrichs ring armature with the others, that it possessed a most advantageous form for the production of currents, and from the results actually obtained with it, his theory of the generation of currents on a ring armature seems to be proved correct.

The main points we observed in Heinrichs' theory were : *that the insulated conducting wire which surrounds the inner portion of the ring armature is out of the influence of the inducing magnets; that the latter take the greatest part in the generation of currents in the former; that the ring core when in action has throughout its greatest length on the inner surface a reversed magnetic polarity to that on the outer surface; the inner reversed polarity will give an impulse to the generation of current in the insulated conducting wire surrounding the inner surface of the ring core, in an opposing direction to the main currents.*

By considering these points of his theory we must say that his channelled ring armature, an outcome of his theory, is the best improvement yet made on the Paccinotti armature, since it obviates all the disadvantages of the other ring forms; besides, with its surrounding inducing magnets it utilises the greatest length possible of the insulated conducting wire for the generation of electric currents.

Mr. Heinrichs obtains three and four lights, of 1,800 to 2,000 candle-power, with 900 revolutions per minute of his armature, which is slightly larger than the one which Gramme employs for his single light generator. In fig. 1 we show a general view of Heinrichs' dynamo machine, $\frac{1}{4}$th of the full size, from which cannot be seen the main differences of this machine from others already so familiar to us, the channelled ring armature being, with great advantage, entirely inclosed by the inducing magnets. The brushes and terminals being very suitably arranged.°

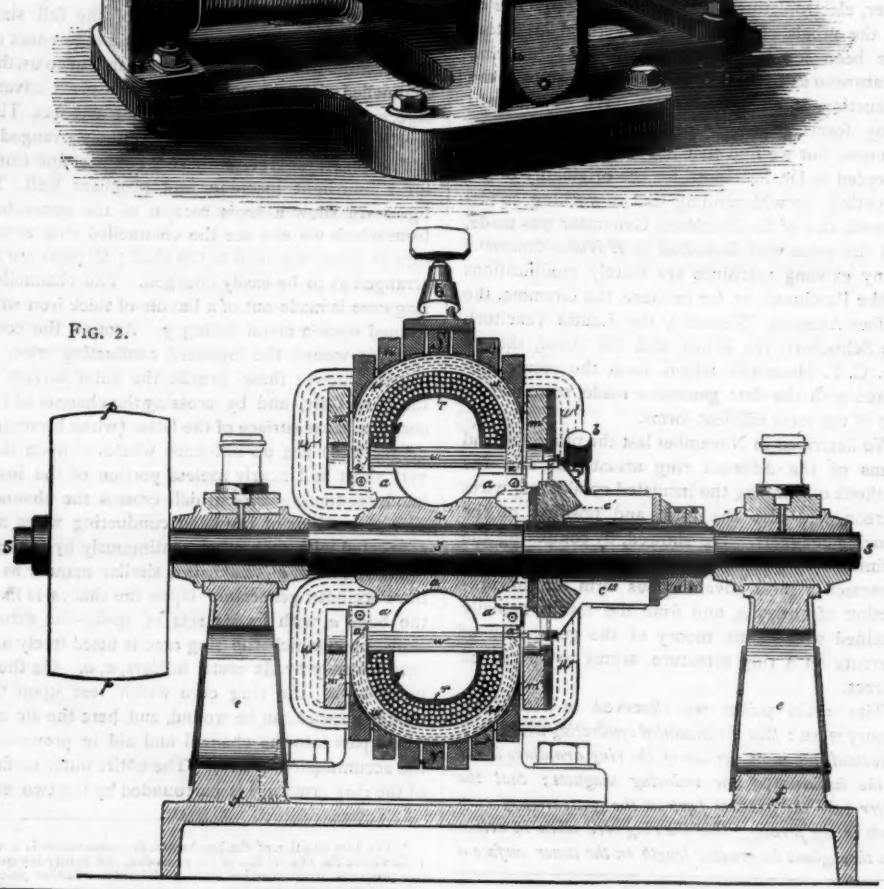
The generator is certainly very compact and small for a four-light machine, and promises well. In fig. 2 we show a cross section of the generator, from which we can see the channelled ring armature as fitted and held to the shaft; all parts are so arranged as to be easily changed. The channelled ring core is made out of a bundle of thick iron wire formed upon a metal casing, *g*. Around the core, r_1 r_1, is wound the insulated conducting wire, *w*, in 36 sections; these overlie the outer surface of the core only, and by crossing the channel of the core the inner surface of the latter (when becoming magnetised) has no influence whatever upon that very short and nearly useless portion of the insulated conducting wire which crosses the channel. The 36 sections of insulated conducting wires are connected with each other continuously by 36 commutator plates, e^1 to e^{36}, in a similar manner as in the Paccinotti generator. Upon the shaft, *s*, is fixed the boss, *a*, with its six sets of spoke-like extensions, upon which the ring core is fitted freely and held securely by six metal holders, *a*, *a*. On those portions of the ring core which rest upon the spokes no wire can be wound, and here the air can freely pass into the channel and aid in preventing the accumulation of heat. The entire outer surface of the ring armature is surrounded by the two sets

* British Museum Library.

° The best position of the brushes on the commutator is a very little above the neu ral line of the generator, and hardly any sparks are produced when in action; this is claimed as a further proof of the efficiency of the generator.

FIG. 1.

FIG. 2.



of electric inducing magnets, N and S, each set of which are made out of 9 plates, m^1, m^1, S, m^1, m^1, and m^2, m^2, N, m^2, m^2. When the ring armature, r_1 r_{11}, as fitted to the shaft, s, is rotated within the fields of the inducing magnets, N and S, electric currents will be collected by the brushes, b^1 and b^2, from the commutator, C, and led through the coils of the insulated conducting wire, w^1 w^1 (which surrounds and excites the inducing magnets), to the terminals, and thence to the lamps or places where required. As can be seen, the main difference of this generator lies in the channelled form of the ring armature, which seems to be of great value. It is stated that with this generator Mr. Heinrichs maintains three lights of 2,000 candle-power, with an expenditure of about four to five horse-power, and 800 to 900 revolutions per minute of the armature (four lights are maintained with 1,100 revolutions per minute); but Mr. Heinrichs undertakes to make the generators, without enlarging the size, to supply four lights with the same number of revolutions of the armature, and the same horse-power as the three lights now require.

The figures of light and horse-power are roughly given by comparing the light-power of this system with the figures given by other lights now before the public. Mr. Heinrichs made some experiments with his new light and a Gramme generator (made in Stockport) before his present generator was completed, and he states that he uses the same pressure of steam and the same engine for his three-light as he had to use for the above one-light generator. The number of revolutions of the armature of the latter was above 1,000.

In fig. 3 we show a perspective view of the channelled ring armature, with only a few turns of wire, showing the wire crossing the channel. This view shows the ring core of a large 20-light generator, and where the former is split, which prevents the generation of currents in the same, and also facilitates and quickens the demagnetisation of the mass of iron. Splitting the iron ring is mostly done in large generators, the Brush, for instance. In the Siemens the small cylinder armature is split several times.

In the specification of his patent, Mr. Heinrichs describes many different modifications of his principle of channelled ring armatures and surrounding inducing magnets, of which we have shown the most developed form by fig. 11 in the article on the different armatures, and in which the ring armature is nearly circular in cross-section, and the surrounding inducing magnets of the same form. With this shape greater efficiency ought to be obtainable; but we think the manufacturing difficulties must also be greater, which has led Mr. Heinrichs to adopt the present form.

Having described his generator, we come now to his system of electric lights, shown in figs. 4, 5, 6, and 7, and which are original—not alone in the circular form of the carbon pencils, but also the method by which the arc is maintained.

As is well known, we have had up to now only one electric candle (and its modifications), the Jablochkoff, where the light is maintained without regulating mechanism, and the distance of the arc kept constant. The short burning time of the Jablochkoff candle (only two hours per candle), and the fact that they are only available with alternating currents, is a great drawback to their general and sole application.

All other lamps have some more or less complicated mechanism or arrangements for the feed of the carbons, which are liable to fail: in one lamp differential shunt coils, in combination with a pendulum, are employed for regulating the feed of the carbons. In another, differential shunt-coils, in combination with a glycerine stuffing box, are employed for regulating the feed of the carbons, for a time, of a single lamp not exceeding eight hours; a slight difference in the speed of the motive power produces, nevertheless, irregularities in the lights—the lights extinguish, or the carbon points come in contact while burning, so that some lamps have then to be lowered, and the carbons withdrawn by hand; while in other lamps the carbons are allowed to burn themselves free, which takes several minutes. In all these and other systems straight carbon pencils have been employed.

Further disadvantages of these lamps are that the racks or bars which guide the straight carbons must be longer than the carbons, which will not allow a great length of the latter to be employed. The racks and bars are in gearing with the regulating mechanism, into which they carry the dust of the carbons and thus cause irregularity and stoppage of the lights.

In 1813 Sir Humphrey Davy used in his electric lamps two straight carbon pencils placed vertically above each other, and since that time all lamp improvements have been all more or less in the same direction. In Mr. Heinrichs' lamp the two sets of carbons cross each other, and the arc is formed and maintained at their crossing point.

Mr. Heinrichs patented and made nearly three years ago a very original regulator with circular carbons *, from which time also dates his priority of the application of circular carbon pencils. The regulator did not satisfy Mr. Heinrichs, and knowing the *disadvantages of any regulating mechanism*, he experimented further with a rough model, which constitutes a simple and novel electric candle lamp, *i.e., without any mechanism for regulating the feed of the carbons;* this is shown in a general view by fig. 5, and inclosed in a suitable shade, by fig. 6; this lamp has a burning time of from 20 to 50 hours; the size of the circular carbon pencils is from eight to twelve inches diameter. The distance of the arc is constant and maintained at the same point. As is known, the arc travels through a distance of six inches in the Jablochkoff candle and the Brush lamp.

In Heinrichs' candle no mechanism is below the arc, therefore no shadow results from them. The arc has a very low resistance on account of the four pencils leading the current to the arc; this is of great advantage for subdividing the current, and as this lamp with its long burning time also occupies little space, it must prove to be one of the electric lights of large illuminating power.

The length of the arc is set to the required length to suit the quantity and electromotive force of the current; under these conditions it is impossible for the arc to become any longer, as will be seen in fig. 5; the thickness of the carbon pencils limits the lengthening of the arc. This feature obviates the

* TELEGRAPHIC JOURNAL, Sept. 15th, 1879, fig. 4.

FIG 4.

FIG. 5.

FIG. 6.

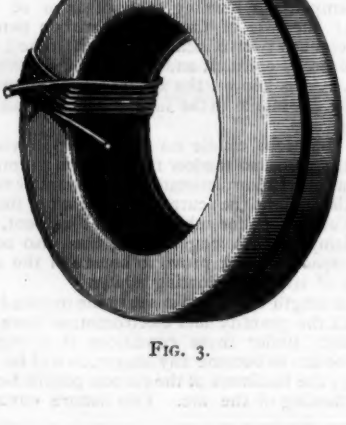


FIG. 3.

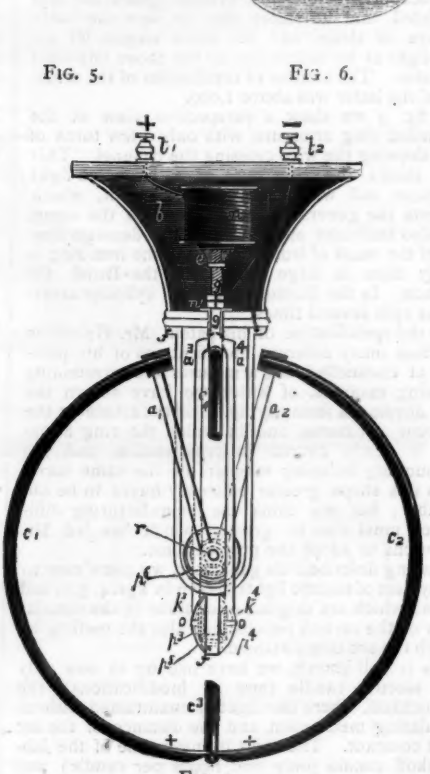


FIG. 7.

employment of shunt-coils, without which other lamps, if several are put in a continuous current circuit, cannot maintain the arc. In some lamps a shunt-coil of 450 ohms is employed, which not only makes the lamp more expensive but is also liable to be destroyed.

In fig. 7 we show the mechanical details of this candle lamp, by which the general view given in fig. 5 can be better understood. The two positive circular carbon pencils, c^1 c^2, are held at one extremity by the two metal arms, a^1 a^2; the other ends are kept in constant contact with each other by the weight of the two arms. The two negative circular carbon pencils, c^3 c^4, are held and kept in constant contact by the two metal arms, a^3 a^4; each set of carbon-holder arms has a common fulcrum, and the two are kept in gearing with each other in the following manner: to the arms, a^1 and a^2, are fixed the pinions, p^1 and p^2, between which two gears the pinion, p^0, and to the arms, a^3 and a^4, is fixed the pinion, p^3 and p^4, between which gears the pinion, p^5. This prevents the arms from falling unequally, and will maintain the contact points of the carbons exactly at the crossing point.

The negative set of carbon-holder arms, a^3 and a^4, have their common fulcrum in the frame, *f f*, which is fixed insulated to the lamp base, *b*. The positive set of carbon-holder arms, a^1 and a^2, have their common fulcrum in the movable frame, *g* (which enters the base, *b*), to which is fixed the armature, *e*. This armature, when attracted by the magnet, *m*, will lift the positive set of carbons, c^1 and c^2, from the negative set of carbons as follows :—When no current passes through the lamp both set of carbons rest in contact with each other at the crossing point. When a current is sent through the lamp in order to start the light, the positive current enters the terminal, l^1, passes to the lamp magnet, *m*, into the metal boss, *n*, which is in contact with the movable base, *g*, thence to the metal arms, a^1 a^2, into the two carbons, c^1 and c^2.

The negative current enters the terminal, l^2, thence to the frame, *f f*, into the metal arm, a^3 a^4, to the two carbons, c^3 c^4, when the magnet, *m*, will attract the armature, *e*, which will lift the positive set of carbons a sufficient distance away from the negative set of carbons, when the arc will be formed and maintained as long as the current passes through the lamp at the crossing point of the two set of circular carbon pencils. Each set of carbons keep falling together (by the weight of the respective metal arms which guide the carbons) as the carbons are consumed. As seen, the lamp is perfectly simple: no chains, cords, or racks are employed. The simple system of pinion is thoroughly covered by metal covers; thus we have no parts in this lamp liable to come out of order by usual treatment, nor any adjustment or regulation required after the lamp has been put into its circuits.

THE TELEPHONIC SYSTEMS OF DR. CORNELIUS HERZ.

By TH. DU MONCEL.

IN spite of the progress accomplished in telephony since the invention was first brought out, there has not yet been produced a telephone which will reproduce speech at a great distance sufficiently clearly and strongly to satisfy the public. One is convinced of this by the fact that certain discontented subscribers to telephonic exchanges declare that they cannot hear at all. Certainly this defect of understanding is often due to a defect in the organ of hearing as regards telephonic sounds, and above all to a defective education of the ear for this kind of correspondence; but it must also be due in a great measure to causes which extinguish and confuse sounds telephonically reproduced, above all when they are transmitted through a telegraph line, subject at all times to accidental currents of all kinds, such as earth currents, induced currents, atmospheric currents, &c.

In order to overcome these currents, on a rather long line, it is necessary that the undulatory currents transmitted should have a certain energy, and it has been necessary to employ battery telephones; but, as the variations of resistance determined by the transmitting apparatus in order to furnish these undulatory currents are always sufficiently feeble relative to the resistance of the entire line, the inflexions of the electric waves are not sufficiently characterised to furnish all the small sinuosities which correspond to articulate sounds; they are effaced more or less by the resistance of the line, and are mutilated by the accidental electric currents which pass over them. In order to avoid this inconvenience, it is necessary to solve two problems: 1st, to increase considerably the amplitude of the electrical vibrations without its being necessary to increase the power of the voice, and 2nd to do this in such a manner that the electric currents foreign to those directly transmitted may not traverse the telephonic circuit. These are the two problems which have been solved by Dr. Herz in the telephonic systems of which we have already spoken, but which we shall completely describe.

In order to obtain these reinforcements of the electric waves several means can be employed: the first is the system of derivation, which was referred to in a previous article; the second is a microphonic system, presenting a great number of partially conducting points, but arranged in such a manner as not to furnish too high a resistance; the third, in the case of the employment of induced undulatory currents, transmitted by an induction coil, is a system able to augment the amplitude of the electric waves by the prolongment of the duration of these induced currents themselves. All these means have been employed and patented by M. Herz, and have furnished good results. As regards the second part of the problem, it has been solved by the means used on submarine cables, that is to say, by the interruption of the circuit itself, and the interposition in the circuit either of condensers, or of diffusers of electric charges, as, for instance, lightning-protectors with points or combs. By the employment as a receiver of a speaking condenser, the problem becomes resolved directly by the introduction of the apparatus itself in the circuit; but by employing ordinary telephones, the introduction of combs or condensers between the apparatus and earth satisfies the desideratum which has been pointed out. It can be understood, in effect, easily, that the interruption of the circuit completely hinders accidental currents from being propagated, or, at least, if they are propagated, they

cannot be of such power as to affect telephonic transmissions. We will now show how some of these systems have been arranged. We will describe later on the others, which are the most important, when the time comes to make them known.

The first system, put to test in the experiments made last autumn between Brest and Penzance, had as a transmitter the apparatus shown in elevation by fig. 1, and in plan by fig. 2; the electrical arrangements being shown by fig. 3. But in order to explain the principle, fig. 4 is given, which represents the whole arrangement with the condenser and comb in circuit. In this figure, the transmitter is represented by the multiple contacts of the microphonic system, and it is, as can be seen, joined up as a derivation from the battery, each cell being connected to a different part of the arrangement. Each of the system of contacts is composed of a plate of carbon, or, better still, of a plate of iron pyrites or pyrolusite, upon which rest points of carbon or pyrites, carried by hinge levers, the pressure of which can be regulated by springs. These levers are mounted on metallic columns, as

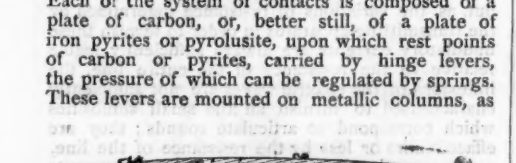


FIG. 1.

seen in fig. 1; and, in order to understand better the arrangement, two of these levers are shown as dropped down. The moderately conducting plates are fixed (six in number) on a vibrating disc, which forms the upper part of the apparatus, and are ranged around the centre of this disc, as seen in figs. 2 and 3. It is of the upper part of this disc of which we speak.

Each of the plates of pyrites communicates, as can be seen in figs. 3 and 4, with the plates connecting the elements of the battery, in such a manner that the current emanating from each element traverses each contact, and, as there are two contacts to each plate, the battery should be composed of twelve elements, joined up in series. In order that all these contacts may furnish a continuous connection from one extremity of the chain to the other, and at the same time be able to act independently and distinctly, the points of the contact levers are connected by a branch from one plate to the other, by means of a forked wire conductor, as seen in figs. 3 and 4. A glance at the arrangement will show that the current from the first element to the left of the battery passes directly to earth by passing through the first contact to the left of plate No. 1. The current of the second element passes in like manner to earth by passing through the second contact of the plate No. 1, thence by the first contact. The current from the third element passes first by the plate No. 2, the first contact to the left of this plate, the forked wire of the second contact of the first plate, the two contacts of this plate, and lastly goes to earth; it is the same for all the other elements of the battery. As the first element to the left of the battery corresponds with others to earth, it can be seen that all the individual currents of the elements of the battery have two paths to flow by: the circuit of the transmitter contacts and the circuit of the line. This arrangement has been taken in order to diminish, in a great proportion, the resistance of twelve contacts of the transmitter, which is considerable, and to introduce them on a derivation to earth, in order to amplify the variations of the transmitter resistance. By this arrangement, then, there are two causes of the amplification of the variations: 1st, that which results from the derivation; 2nd, that which results from the increase in the number of contacts; and by the fact of the derivations effected at each element of the battery, the total resistance of the transmitter is thus diminished in a sufficiently great proportion.

In order to be able to judge of the importance of the derivation system under these conditions, we will make a little calculation. We will call b the circuit of the line, a the derivation circuit constituted by the contacts of the transmitter, E the electromotive force of the battery, and r its resistance. According to Ohm's law, the current strength, C, when the transmitter of a resistance, a, is introduced into the circuit, is :—$C = \frac{E}{r+a+b}$, and for this same value of C, in the case where the transmitter constitutes the derivation : $C^1 = \frac{E}{r + \frac{r\,b}{a} + b}$; this last formula only differs from the other by the quantity intermediate between r and b, which is simply a in the first case, and $\frac{r\,b}{a}$ in the second case.

Now, it is easy to see, by the form of these two expressions, that the variations of a will affect much more the value of C in one case than in the other. Suppose, for example, $r = 5$ ohms, $a = 10$ ohms and $b = 100$ ohms: the total resistance, forming the division of E, will be, in the case of the simple circuit, $5 + 10 + 100 = 115$ ohms, and in the case of the derivation, it will be, $5 + \frac{100 \times 5}{10} + 100 = 155$. Now let us admit that, in consequence of a difference of pressure in the contacts, a became reduced to 2 ohms, the resistance in the first case will be changed to 113 ohms, but in the second it will change to 168 ohms. The variation in the intensity of the current in the telephone circuit will be in the first case from 1 to 1·017, and in the second case from 1 to 1·084. We can see, therefore, how much is gained in sensibility by the combination by the derivation system.

In the first experiments made with this system of transmitter between Brest and Penzance, various magnetic telephones were employed as receivers, and experiments were made with and without a

condenser interposed in the line, and also with and without a comb lightning-protector, as shown by fig. 4. The results were already sufficiently satisfactory to encourage one to persevere with the problem; and it was at that time that the results were announced in the different journals, and in *La Lumière Electrique*, on 15th September, 1880.

From a practical point of view, the arrangement indicated by fig. 1 had several inconveniences; it required a very careful adjustment of all the contact levers, and, when an adjustment is necessary in telephonic apparatus, the latter ceases to be of practical value. It was sought, therefore, to remedy this inconvenience; and this was done in an extremely simple manner by means of the apparatus represented in vertical section by fig. 5, and in plan by fig. 6. In this apparatus the contacts are formed of discs of pyrites or other metallic sulphides, and are suspended in pairs, by means of tongues, to a thin wooden board, which serves as a vibrating plate. Under these conditions, the surfaces of contact are sufficiently developed to diminish the resistance of the apparatus; and to insure good contact, weights of lead are attached to each set of discs, as shown in fig. 5. The electrical connections are in other respects effected as shown by fig. 6, and, as regards the rest of the arrangement, it is similar to that in the first system; only, as there are more plates furnished with double contacts, the number of contact couples is twelve instead of six, and the forked connections are effected on an upper and lower disc. Experiment has shown completely that it is possible to simplify this system, and to reduce the number of couples to three. It was with an apparatus of this kind that the decisive experiments were commenced, three months ago, between Orleans, Blois, Tours, Poitiers, Angoulême, and Bordeaux; these led to the important results which have been announced, and in these experiments numerous studies were made with reference to the best arrangement to give to the battery as regards connecting it up to the contacts of the transmitter. Thus, a combination of the cells in series was tried, so that there was at each contact a double element (joined up in quantity), the contacts being all joined up in series. This arrangement had an advantage in certain cases, whilst in others it was the combination by simple elements that answered best. Induction coils were tried in connection with these systems, one for each contact; then the elements of the battery were connected, one to each contact, and passed through the primary circuit of the corresponding bobbin. In this case all the secondary circuits were joined up in quantity, and thus connected to the line and earth. Good results were obtained with this arrangement, but it was too complicated. There were also tried transmitters with three, six, and twelve pairs of contact discs, but always in employing the system of derivation, and with a number of battery elements equal to that of the disc couples, each element was itself composed of two elements joined up for quantity, the whole being joined up in series with derivations to the transmitter between each element or group of elements. As a receiver, magnetic telephones were employed, but also the speaking condenser, and to this subject it will not be uninteresting to point out the various experiments which were made about a year ago with this interesting instrument.

On the 23rd June, 1880, M. Herz, having asked me to assist him at experiments made at the Boulevard Saint-Marcel, my attention was attracted by the fact that a condenser of small dimensions could, under certain conditions, reproduce speech. I can testify to this fact, and I was very much astonished at it; however, when it was shown that the transmitter was interposed on a derivation, and that this transmitter was that represented by fig. 1, and charged by a strong battery, I could understand the reason of the effect; but, on my being asked to keep secret what I had seen, I could not continue my investigations, and I had even forgotten the arrangement of the experiments, when M. Dunand explained to me his system of a speaking condenser, in which he employed a second battery, placed near the condenser, in order to polarise it in a constant manner. I recollect that M. Herz only employed one battery, and I thought I saw a difference in the two systems. However, on consulting the patents of M. Herz, I remarked that, *in consequence of the arrangement of the transmitter in derivation, the condenser employed as a receiver became always charged to the potential of the battery*, and that *the action of the transmitter had no other effect than that of diminishing more or less the potential at the moment of its action, and consequently to reflect by the condenser all the variations of resistance determined by the sonorous waves of the voice.* Fig. 7, extracted from the patent of June 9th of M. Herz, represents in effect the arrangement of the experiment, which can leave no doubt on the subject.

Since the time when I saw the experiments in question, the speaking condenser was experimented with always, and it took some time before the most advantageous arrangement of the battery was found out in order to make the condenser speak strongly. When experiments were made between Brest and Penzance it was tried without yielding satisfactory results; this was not the case between Orleans and Bordeaux; and since this time no efforts were spared to make the arrangement perfect, and the results have been that good work has been obtained on circuits the most difficult for telephonic transmission, but in employing another transmitter, which cannot be described at this moment, and to which the first electric combination has been appropriated in a peculiar manner, susceptible of application to induced currents. It is a result highly important, as has been said at the commencement of the article, that this system presents the extreme advantage of the line being cut, so that accidental and abnormal currents are cut off. We represent the arrangement by fig. 8. Fig. 9 shows an outside view of one of the numerous forms the instrument has assumed.

In the course of the experiments of which we have spoken, condensers of an electrostatic capacity of 5 to 10 microfarads were interposed in the circuit, and also comb lightning-protectors, which are shown by figs. 10 and 11; but the results obtained were not as good as were expected, in consequence of the decrease which their presence produced in the intensity of the transmitted currents; nevertheless, one may judge of the part which they can play in preventing the effects of abnormal and accidental currents. It may be remarked that with the new

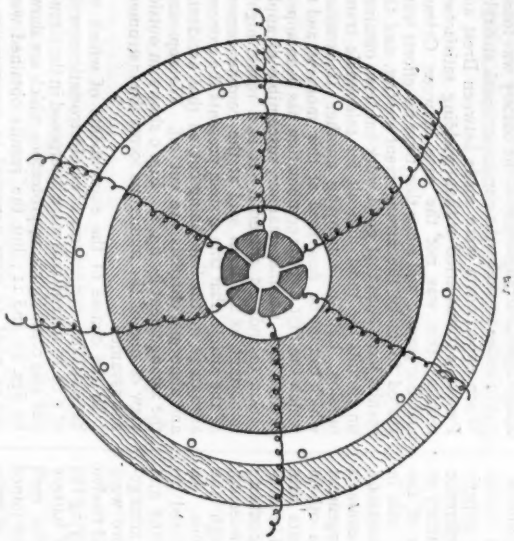


FIG. 2.

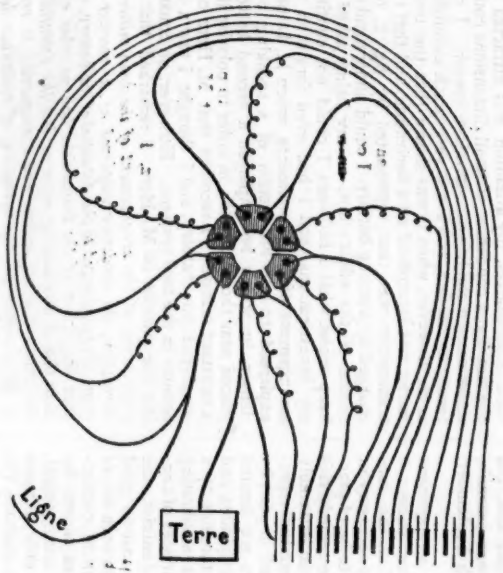


FIG. 3.

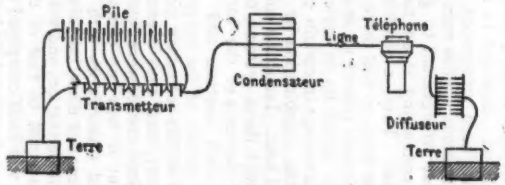


FIG. 4.

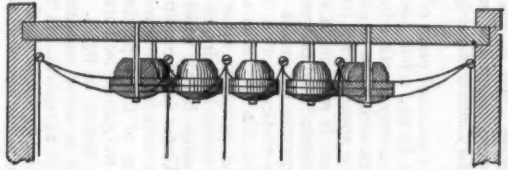
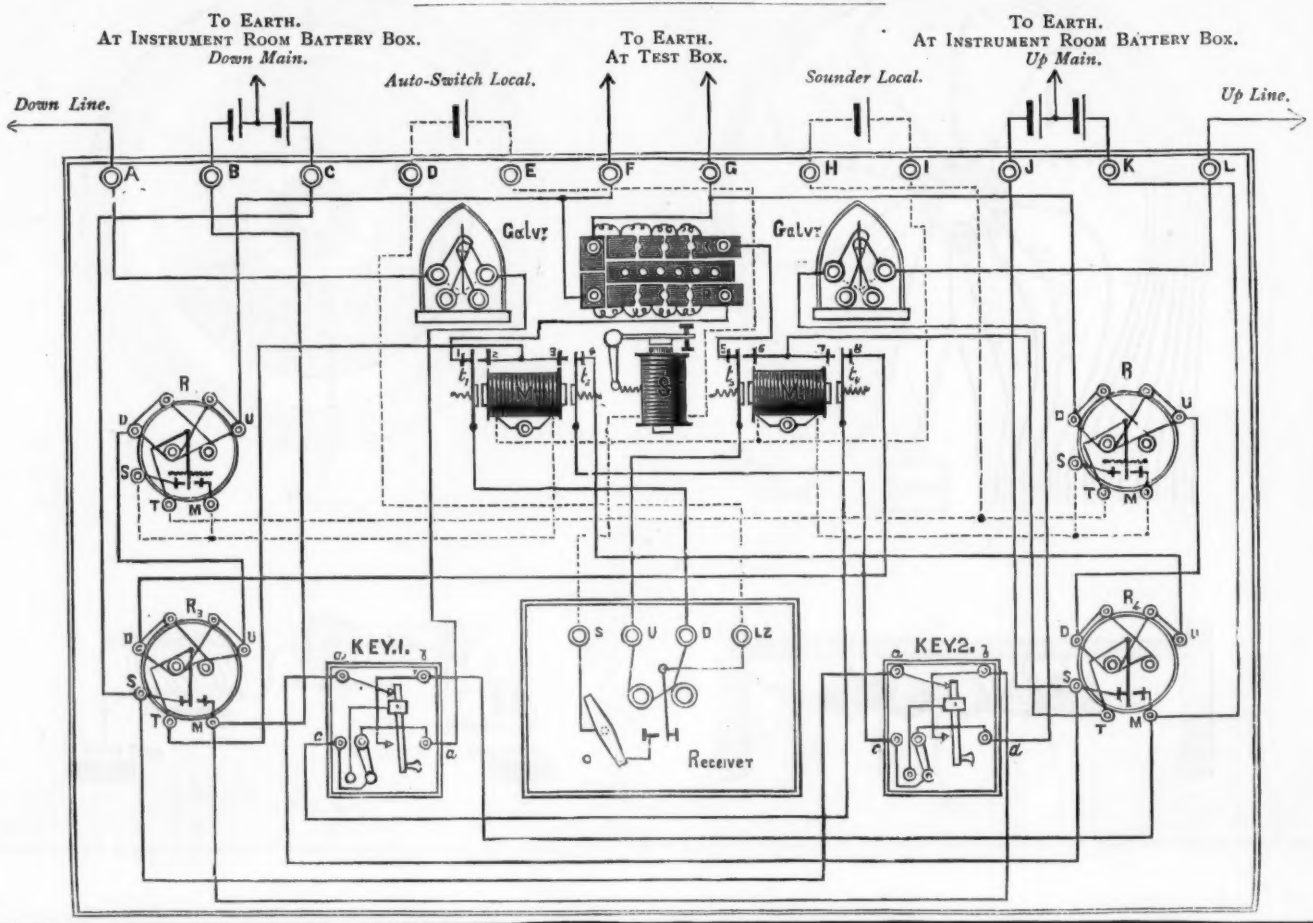


FIG. 5.

Fig 115

AUTOMATIC FAST-SPEED TRANSLATOR.



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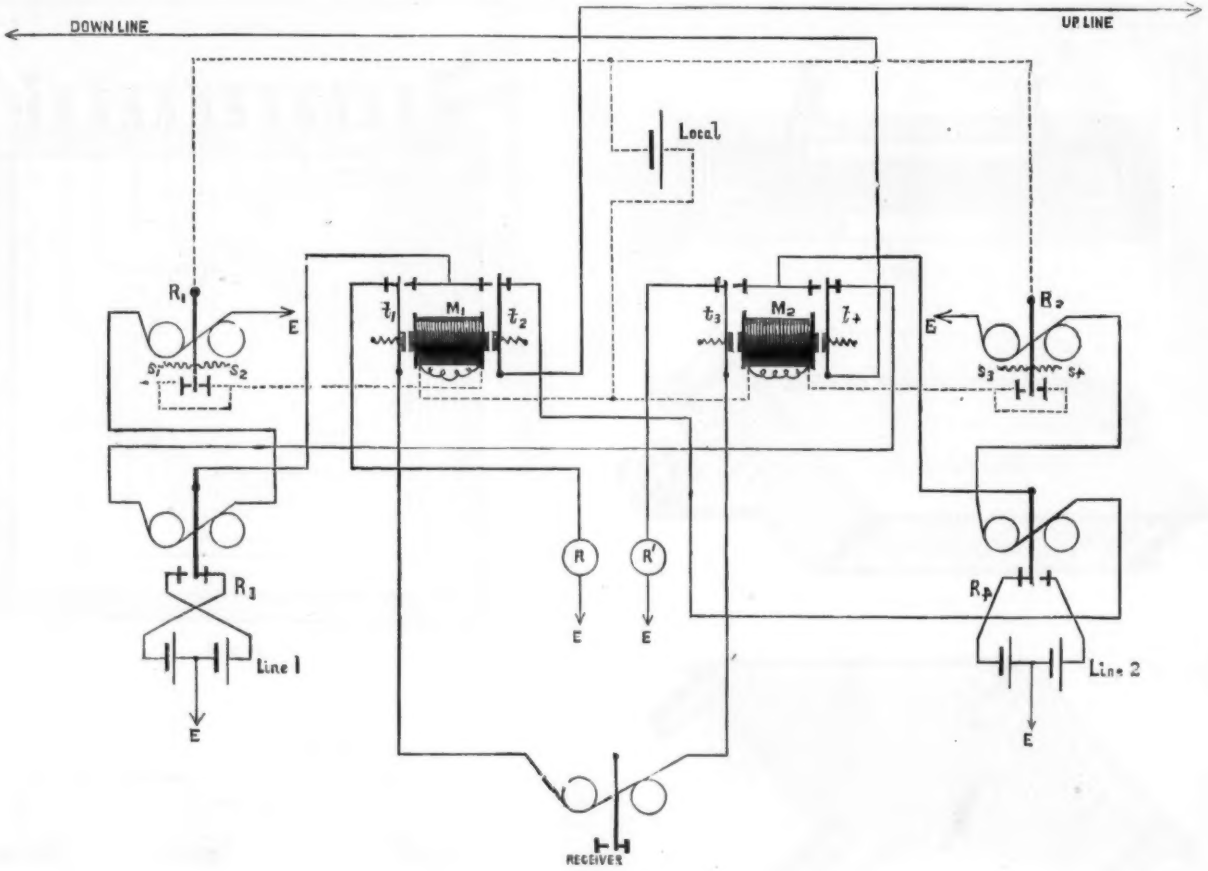
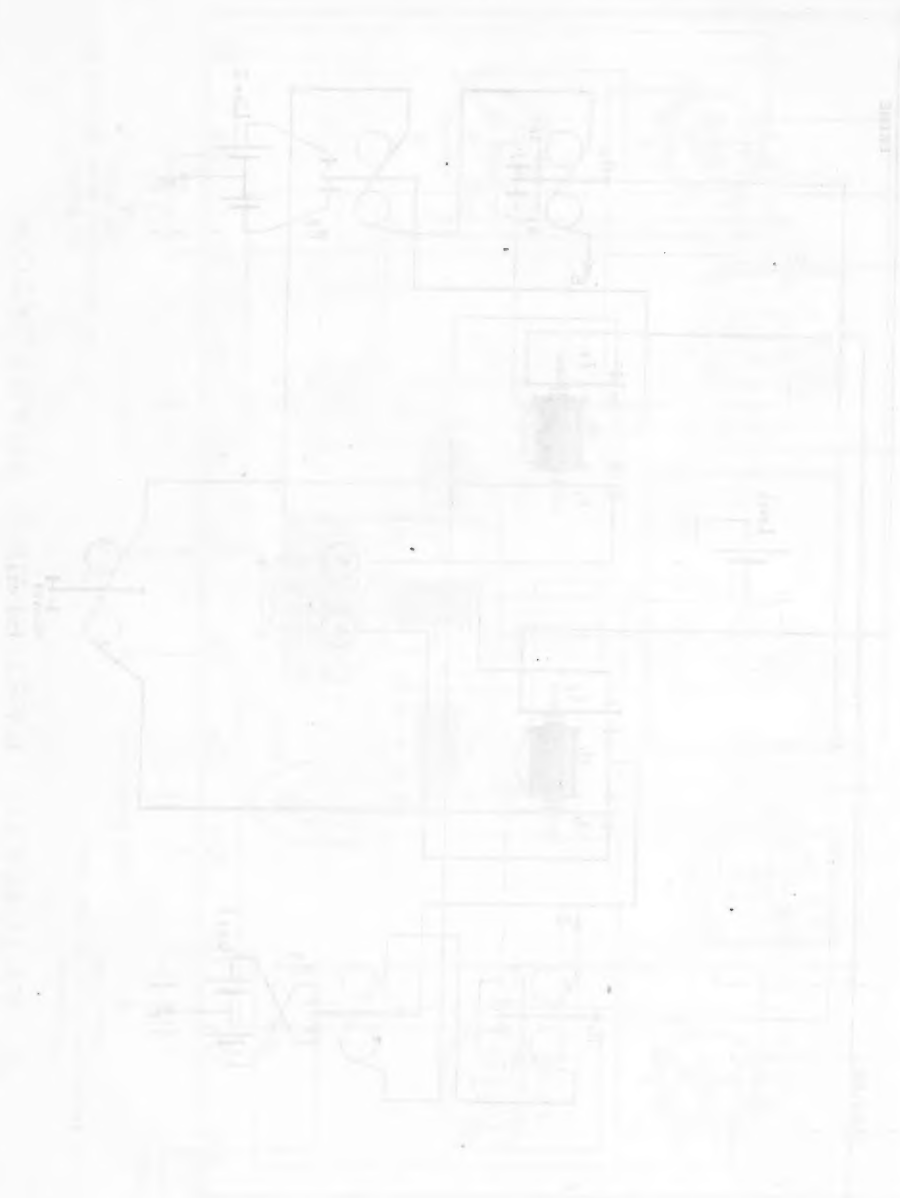


FIG. 113.



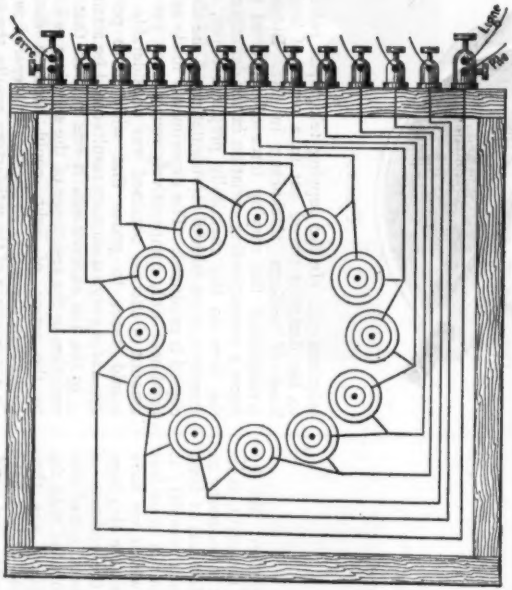


FIG. 6.

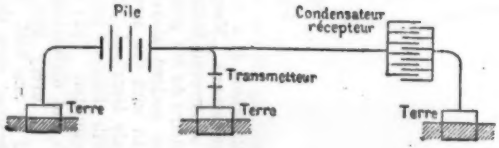


FIG. 7.

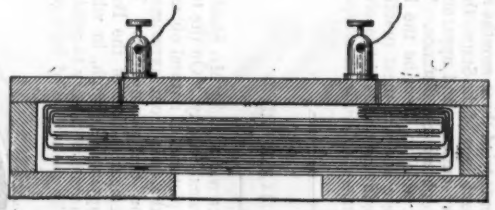


FIG. 8.

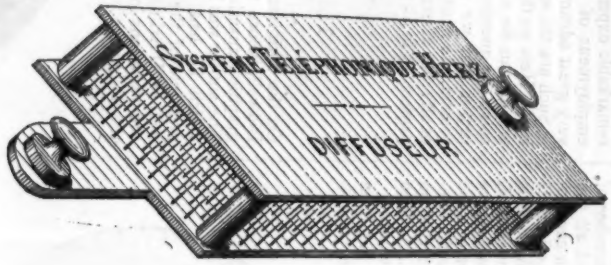


FIG. 10.

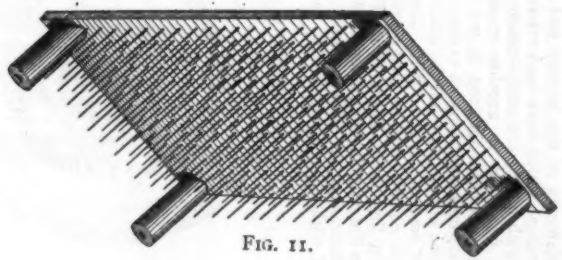


FIG. 11.

transmitters, of which we cannot yet speak, it has been possible to reduce considerably the number of the elements of the battery, and to avoid all the derivations which have been referred to in connection with fig. 1; the amplification of the effects is then produced in another manner. With this system has been obtained, as we have announced, the transmission of speech to the enormous distance of 1,100 kilometres; but the absolute silence of the night was necessary. With three Lelanché elements, correspondence could easily be carried on on the lines from Paris, Tours, Poitiers, &c., even when the neighbouring lines were in full work.

The transmitter with multiple contacts has been tried with success, without the battery derivations,

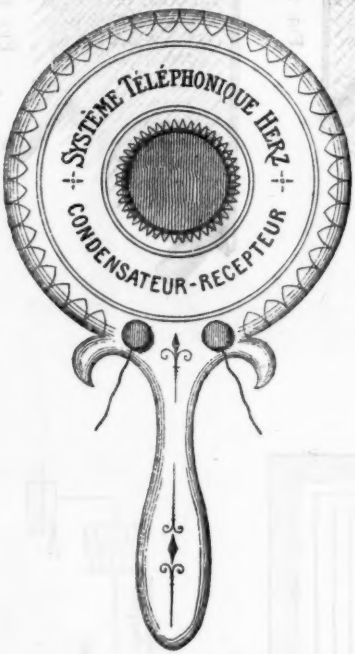


FIG. 9.

by connecting all the contacts together, but by interposing them as a derivation to the earth, as in the other systems. Nevertheless, it is necessary to employ a powerful battery of 32 elements at least (64 elements do not give a much better result); it has been noticed also that the sounds were less clear than with the arrangements which we have previously described. Experiments have also been made with different groupings of the contacts of the transmitter. Thus they have been joined two and two, and derivations only established with the battery at every two. The battery was thus reduced to one half. Equally good results have been obtained with this arrangement; less good, however, than with the arrangement which has been explained.

The speaking condenser has worked very well between Paris and Orleans, and between Paris and Tours. Besides, in Paris itself, several recent remarkable experiments have demonstrated that the employment of the speaking condenser presents very great advantages for telephonic offices.

Such are the experiments tried three months ago by M. Herz on the different lines of the State; they are, as can be seen, very curious, and apparently solve the question of telephony to a distance. We regret that we are not able to describe the last system, the most complete and the most practical of all; but at present the invention has not received protection in all countries.—*La Lumière Electrique.*

TELE-PHOTOGRAPHY.

ON the 26th inst. a paper was read by Mr. Shelford Bidwell, before the Physical Society, "On the telegraphic transmission of pictures of natural objects." The author was led to the idea from experiments which he had made on the photophone. The principle of the arrangement is that of the Bakewell or D'Arlincourt copying telegraph, in which the variations of the current necessary to produce the design are effected by the action of light on a

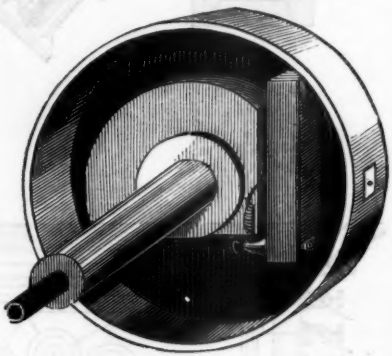


FIG. 1.

selenium cell. In the copying telegraphs referred to, the design is traced out in a series of broken lines of uniform thickness; in Mr. Bidwell's arrangement the varying force of a current produces a corresponding variation in the definition of the lines on the chemically prepared paper, and thereby a more faithful representation of the object copied is produced. The experiments made as yet have been only comparatively rough ones, yet the amount of success obtained was considerable, and would seem to prove that with more perfect apparatus very satisfactory results could be attained.

In the first experiments it was proved that the variation in the resistance of the selenium cell, due to the action of light, could produce distinct changes in the marks on chemically prepared paper. In consequence of the satisfactory results, the apparatus, of which we give an illustration, and for which we are indebted to Mr. Bidwell, was devised.

The transmitting instrument consists of a cylindrical brass box (fig. 1) four inches in diameter and

two inches deep, mounted axially upon a brass spindle seven inches long, and insulated from it by boxwood rings. The spindle is divided in the middle, its two halves being rigidly connected together by an insulating joint of boxwood. One of the projecting ends of the spindle has a screw cut upon it of sixty-four threads to the inch; the other end is left plain. The spindle revolves in two brass bearings, the distance between which is equal to twice the length of the cylinder; and one of the bearings has an inside screw corresponding to that upon the spindle. At a point midway between the two ends of the cylinder a hole, H (fig. 2), a quarter of an inch in diameter is drilled, and behind this hole is fixed a selenium cell (figs. 3 and 4), the two terminals of which are connected respectively with the two halves of the spindle. The bearings in which the spindle turns are joined by copper wires to two binding screws on the stand of the instrument. This transmitter is represented in general view by fig. 1, and in diagram in fig. 5, where H is the hole in the cylinder opposite the selenium cell.

The receiving instrument contains another cylinder similar to that of the transmitter, and mounted upon a similar spindle, which however is not divided nor insulated from the cylinder. An upright pillar, D (figs. 2 and 5), fixed midway between the two bearings, and slightly higher than the cylinder, carries an elastic brass arm fitted with a platinum point, P, which presses normally upon the surface of the cylinder. To the brass arm a binding screw is attached, and a second binding screw in the stand is joined by a wire to one of the brass bearings.

To prepare the instruments for work they are joined up as shown in figs. 2 and 5, two batteries, B, B_1, a set of resistance coils, R, and a galvanometer, G, being used. The cylinder of the transmitting instru-

FIG. 3

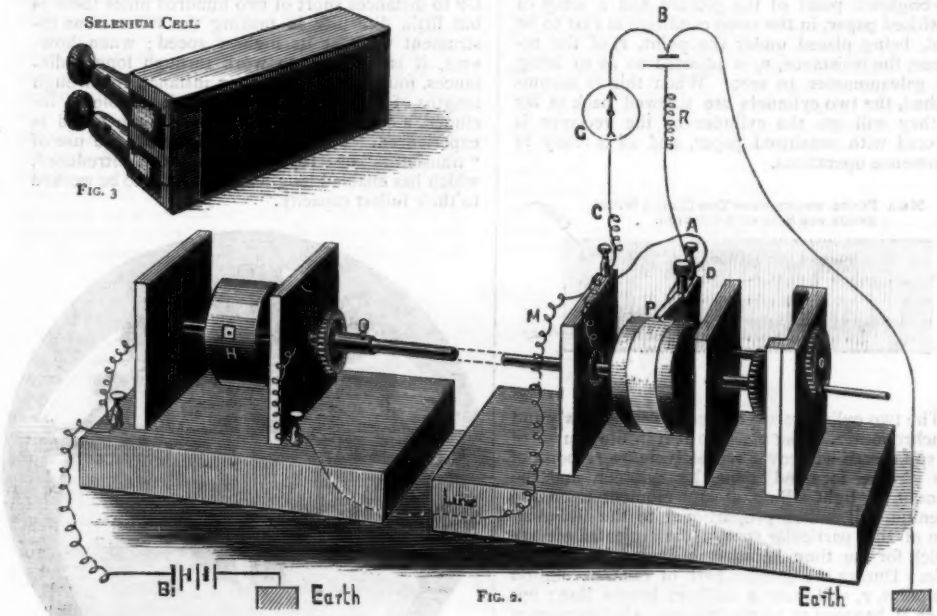


FIG. 2.

FIG. 6.
IMAGE FOCUSSED UPON TRANSMITTER.

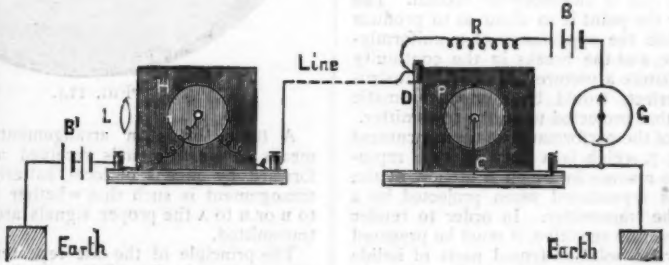


FIG. 5.

FIG. 7.
IMAGE AS REPRODUCED BY RECEIVER.

ment is brought to its middle position, and a picture not more than two inches square is focussed upon its surface by the lens, L (fig. 5). The pictures upon which the author operated have been mostly simple geometrical designs cut out of tin-foil and projected by a magic lantern. The comparatively large opening, H, is covered with a piece of tin-foil, in which is pricked a hole, which should be only just large enough to allow the instrument to work. The hole is then brought, by turning round the cylinder, to the brightest point of the picture, and a scrap of sensitised paper, in the same condition as that to be used, being placed under the point, P, of the receiver, the resistance, R, is adjusted so as to bring the galvanometer to zero. When this is accomplished, the two cylinders are screwed back as far as they will go, the cylinder of the receiver is covered with sensitised paper, and all is ready to commence operations.

MICA PLATE, WOUND WITH TWO COPPER WIRES READY FOR SELENIUM COATING.

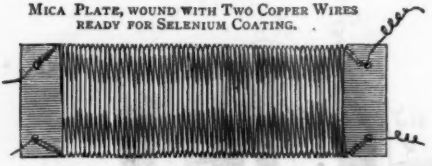


FIG. 4.

The two cylinders are caused to rotate slowly and synchronously. The pin-hole at H in the course of its spiral path will cover successively every point of the picture focussed upon the cylinder, and the amount of light falling at any moment upon the selenium cell will be proportional to the illumination of that particular spot of the projected picture which for the time being is occupied by the pin-hole. During the greater part of each revolution the point, P, will trace a uniform brown line; but when H happens to be passing over a bright part of the picture this line is enfeebled or broken. The spiral traced by the point is so close as to produce at a little distance the appearance of a uniformly-coloured surface, and the breaks in the continuity of the line constitute a picture which, if the instrument were perfect, would be a monochromatic counterpart of that projected upon the transmitter.

An example of the performance of the instrument is shown in fig. 7, which is a very accurate representation of the manner in which a stencil of the form of fig. 6 is reproduced when projected by a lantern upon the transmitter. In order to render the paper sufficiently sensitive, it must be prepared with a very strong solution (equal parts of iodide and water), and when this is used the brown marks disappear completely in less than two hours after their formation. There is little doubt that a solution might be discovered which would give permanent results with equal or even greater sensitiveness, and it seems reasonable to suppose that some of the unstable compounds used in photography might be found suitable.

Although, in the apparatus shown by fig. 2 the transmitter and receiver are connected mechanically together, they can of course be joined electrically, as in D'Arlincourt's apparatus (TELEGRAPHIC JOURNAL, January 15th, 1879).

TELEGRAPHIC APPARATUS IN USE IN THE BRITISH POSTAL TELEGRAPH DEPARTMENT.

XXVIII.

THE WHEATSTONE AUTOMATIC SYSTEM.

(Continued.)

FAST TRANSLATORS.

UP to distances short of two hundred miles there is but little difficulty in making the Wheatstone instrument work at its highest speed; when, however, it is required to work through longer distances, four hundred miles for instance, or through lengths of line in which a submarine cable is included, a considerable diminution in the speed is experienced. To get over this difficulty the use of "translators" or "repeaters" has been introduced, which has enabled long lengths of line to be worked to their fullest capacity.

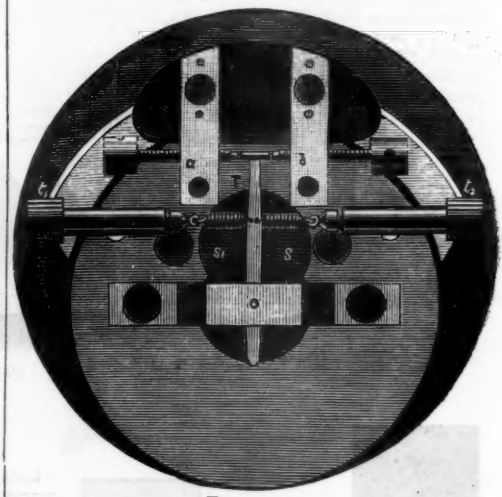


FIG. 114.

A translator is an arrangement of relays by means of which signals received are transmitted forward by means of local batteries; the whole arrangement is such that whether station A sends to B or B to A the proper signals are automatically transmitted.

The principle of the fast repeater as at present employed by the Post Office is shown by fig. 113. R_3, R_4 are two Post Office standard relays (Article V., March 15th, 1880) of the ordinary pattern. R_1, R_2 are also standard relays with additions, which are shown by fig. 114. t_1, t_2 are two thumb screws connected to two short spiral springs, s_1, s_2, by means of which the tensions of the latter can be regulated. These springs are connected to the tongue, T, and by their tensile force keep the contact piece of the latter intermediate between the contact screws, *a* and *b*. Thus when a series of reversed current are are sent through the relay the tongue, T, is attracted over against one contact stop or the other,

but when the currents cease, T remains intermediate between *a* and *b*, and touching neither.

M_1 and M_2 are "automatic switches," one of which is shown by fig. 116. This piece of apparatus consists of two electro-magnet bobbins provided with two armatures, one at each end; each armature has a contact tongue, which play between contact points. When no current passes through the electro-magnets, the tongues rest against the outer contact screws, but when attracted they make contact with the inner contact screws.

Between the ends of the electro-magnet coils a *shunt*, equal in resistance to the former, is connected. This shunt is placed in the base of the instrument, and its object is to prolong the duration of the magnetism induced in the cores by the action of the current; thus, if a current be sent through the coils and the armatures become attracted, then when the current is taken off the armatures do not immediately fly back but are held attracted for a second or two. If then a series of intermittent currents pass rapidly through the coils of the automatic switch the armatures become

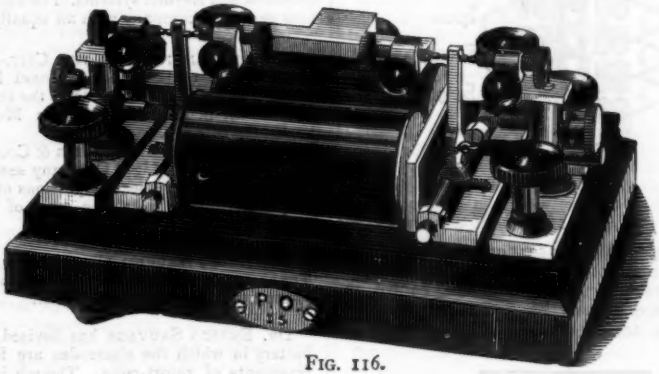


FIG. 116.

attracted and held steadily against the inner contact screws as long as their currents continue to pass.

Referring to figs. 113 and 115, it will be seen that the contact points of relay R_1 are both connected to one end of the coils of the switch, and the tongue of the relay is connected to one pole of a local battery, the other pole of the latter being connected to the second end of the coils of the switch. The local battery referred to is also connected to relay R_2 and automatic switch M_2. Now if the tongue of, say relay R_1, be caused to vibrate against its contact stops, $_{1,2}$, by a series of reversed currents passing through its coils, then the circuit of the automatic switch and local battery will be closed each time the relay tongue touches either stop; and, inasmuch as the period of no contact, whilst the tongue is passing from one contact to another, is very brief, the action of the shunt is sufficient to "bridge over" this interval and to keep the armatures firmly attracted during the whole time the tongue of the relay continues to vibrate. Directly the current ceases, however, and the relay tongue assumes its neutral position, then the local circuit becomes entirely open and the switch tongues fall back against their back contact stops.

In circuit with relays, R_1 and R_2, respectively, are two standard relays of the ordinary pattern, R_3 and R_4. These relays have their contact screws connected to the poles of "split" batteries (line 1 and line 2); the split of the batteries being connected to earth. The vibrations of the tongues of these relays will cause reversed currents to be sent out through their tongues from these split batteries.

Suppose, now, a series of signals from the automatic transmitters connected to the "Up line" to be received, these signals will pass from the Up line to tongue, t_3, of the automatic switch, M_1; from thence they will pass through the right hand outer contact to the relay, R_4, and from the latter they will go through relay, R_4, and to earth. The two relays will consequently respond to the signals, and relay, R_2, will, by its action, cause the automatic switch, M_2, to "close"; that is to say, to attract its armatures and draw its tongues, t_3, t_4, against the inside contact stops. The circuit of the line 2 battery connected to relay, R_2, is now complete through the tongue of the latter and through the inside right-hand contact screw of M_2 to tongue, t_4, and from thence to "Down line." Thus, the signals received from the "Up line" are repeated to the Down line by means of the line 2 battery.

It will be noticed that a portion of the current from the line battery will split between the inside right-hand and the inside left-hand contact screws of the switch, M_2; the second portion of the current passing through tongue, t_3, and a "Receiver" (Article XXV.) and from thence through tongue, t_1, and a resistance, R, to earth. This resistance coil is of a very high value, so that it drains off but a very small portion of the current from the split battery, the major portion going out to the "Down" line.

The receiver is of the ordinary Wheatstone form, and receives a copy, as it were, of the signals sent out to the "Down" line. This enables the clerk in charge of the translator to see whether the signals are being properly transmitted. This receiver is also in circuit, through tongue, t_2, with the resistance coil, R^1, so that when signals are being sent from the Down line and repeated on the "Up" line, the state of the signals in this case also can be seen.

The action of the translator when the "Down"

line is sending signals is obviously the same as has been described, only in this case the relays, R_1 and R_2, respond, and the automatic switch, M_1, "closes." The actual arrangement of the repeater board, according to the most recent design, is shown by fig. 115.

The "Up" and "Down" lines, before passing to the tongues of the automatic switches, pass through galvanometers, thence through keys 1 and 2 respectively; the currents passing in at terminals *d*, and out at terminals *c* of the keys.

The back and front contacts of the keys 1 and 2 are connected to the poles of the split batteries, and by means of hand switches the levers of the keys can be connected direct to the "Up" and "Down" lines respectively. A sounder, S, is connected to the receiver in the ordinary way, and is

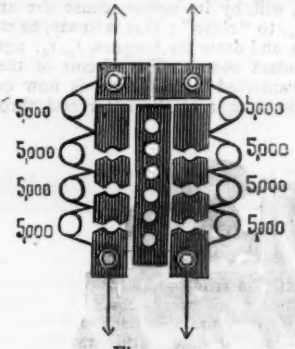


Fig. 117.

used when signals are being sent or received by the hand keys. The resistance coils used in connection with the receiver, and which are known as "leak" coils, are shown by fig. 117. By this means, 5,000 to 20,000 ohms can be inserted in each circuit.

Notes.

THE INVENTION OF THE RETURN WIRE CIRCUIT FOR TELEPHONES.—An interesting controversy as to priority of invention has been going on before the Patent Office for the past two years between Alexander Graham Bell, the telephone inventor, and David Brooks, of Philadelphia, the well-known electrician. The invention in dispute was the use of a return wire on a telephone circuit, to prevent the noises of induction. On some of the city telephone lines the noise produced by induction from electrical currents is so great as to form a serious obstacle to the use of telephone instruments. If one attempts to listen there is such a loud bubbling noise heard, and such a mixture of clicks and other voices, which come in from the neighbouring wires, that the principal satisfaction of conversing with one's correspondent is taken away. If the telephone wire passes in the vicinity of Western Union wires, on which Gray's harmonic telegraph instruments happen to be at work, then there is added to the general confusion of tongues a series of tootings or cat calls that are quite distressing to the ears of sensitive telephoners. Professor Bell and Professor Brooks discovered the remedy; it consists in using two wires on the telephone circuit instead of a single wire. If an extra wire, insulated, is stretched close alongside of the usual single wire, the extra being employed as a return circuit wire instead of the earth, then all noise from induction disappears, and telephoning becomes a pleasure.

The Commissioner of Patents decides that the priority of invention belongs to Prof. Brooks, he having made the invention in July, 1877, whereas Bell did not make it until the end of August, 1877. But, more than this, Bell's date of invention must, by law, be carried forward to the date of the final enrollment of his English patent, May 18, 1878; as it is not allowable, in this country, so far as proofs of invention are concerned, for any applicant, if he takes a foreign patent before he applies for an American patent, to go back of the date of his foreign patent. Bell did not apply for his American patent until December 20, 1878. The Commissioner of Patents, therefore, reversed the decision of the Board of Examiners in Chief, and awards the discovery to Professor Brooks, to whom it clearly belongs.—*Scientific American*.

WE learn from two or three sources that in France a fusion of interests has taken place, as regards the companies representing the Jamin, Jablochkoff, Werdermann and Reynier systems. The whole being formed into one large company with an equally large capital.

ELECTRIC LIGHTING IN THE CITY.—Owing to the bad weather, the engineer (Colonel Haywood, C.E) states that he has had to extend the time for the commencement of experiments, from March 1st to the beginning of April.

MESSRS. SIEMENS BROTHERS & Co. and the Anglo-American Electric Light Company seem to be pushing ahead with their respective portions of the work, but as yet very little is to be seen of the Jablochkoff system.

THE ANGLO AMERICAN ELECTRIC LIGHT COMPANY.—The shares of this company are to be henceforth quoted in the Stock Exchange official list.

DR. ENRICO SAUVAGE has devised a new secondary battery in which the electrodes are formed of porous fragments of retort-coke. Though inferior in power and duration to a Planté element in good condition with electrodes of lead the element in question is cheaper, can be more easily and quickly constructed, and furnishes a current of long duration.

E. MERCADIER (*Il Progresso*) concludes that radiophony does not seem to be an effect produced in the mass of the receiving plate which vibrates transversely in its totality like an ordinary vibratory plate. The nature of the molecules of the recipient and the manner of their aggregation do not seem to exert a predominating influence on the nature of the sounds produced. The radiophonic sounds result principally from an action on the surface of the recipient and the sounds are relatively very intense.

THE French government have under consideration the substitution of the electric for oil lighting in 42 of the lighthouses on the French coast. After a series of experiments which have proved successful, the administration of French lighthouses has given an order to M. de Meritens to build six magneto-electric machines for the three first lighthouses which are to be illuminated by electricity.

M. LEON MANET has devised a process for bleaching blood albumen by means of the electric light.

Proceedings of Societies.

PHYSICAL SOCIETY.—FEBRUARY 12th.

Prof. W. G. ADAMS in the Chair.

THIS being the annual general meeting, the yearly report was read by the chairman. The report showed that the Society now numbered 321 members as against 298 of last year. Two eminent members, Sir T. H. Elliot and the Rev. Arthur Rigg, had been lost by death. The Society had decided to republish the scientific papers of Dr. Joule in a collected form.

Dr. ATKINSON, treasurer, read the balance-sheet for the past year, which showed the Society to be flourishing. The new council and officers were then elected, Sir W. THOMSON retaining the presidency. Mr. BAKEWELL and Herr G. WIEDEMANN were created honorary members. Votes of thanks were passed to the Lords Commissioners of the Council of Education for granting the use of the meeting-room to the Society, to Prof. ADAMS, to Dr. GUTHRIE the demonstrator, the auditors, and the secretaries, Professors RHEINOLD and ROBERTS. The meeting was then resolved into a special general meeting, and a resolution put and carried giving the council power to invest money of the Society in the name of the Society or of persons appointed by them, in certain stock, home and foreign. The meeting was then constituted an ordinary one, and Mr. T. WRIGHTSON, C.E., read a paper by Prof. CHANDLER ROBERTS and himself on the density of fluid bismuth. By means of the oncosimeter, an instrument which records on a band of paper the sinking or floating effect of a ball of the solid metal immersed in the molten metal, they had determined the density of fluid bismuth from six experiments to be 10·055. A former value by a different method was 10·039. In the discussion which ensued Mr. WRIGHTSON stated that his experiments proved solid cast iron to be heavier than fluid, and to sink in the latter when first immersed; but it rapidly became lighter as its temperature rose, till it floated when in its plastic state, and was consequently lighter than when in the molten state. The oncosimeter could be utilised for determining the change of volume in melting rocks, and Prof. CHANDLER ROBERTS suggested that it might throw light on the difference of state between the carbon of gray pig and white iron.

Dr. O. I. LODGE exhibited working models showing the hydrostatic analogies between water and electricity. A battery was represented by a pump, conductors by open pipes, dielectrics by a pipe closed by an elastic membrane, electrometers by pressure gauges. With these analogues he showed the action of a Leyden jar, and the passage of telegraphic signals along a cable.

THE SOCIETY OF TELEGRAPH ENGINEERS AND ELECTRICIANS.

AN ordinary general meeting of this Society was held on Thursday, February 24th, Professor CAREY FOSTER, President, in the chair. The minutes of the last general meeting having been read and confirmed, and the list of new and proposed members read, the discussion on Mr. Alexander J. S. Adams' paper on "Earth Currents and Electric Tides" was continued.

Mr. CHR. DRESING stated that the results of some experiments he had made, and which had been described by him in the TELEGRAPHIC JOURNAL for April 1, 1878, proved that changes in the direction of the earth currents took place every six hours, and the maximum electromotive force attained was three to four Leclanché cells. It was noticed that the changes were gradual, and coincided with the tidal wave.

Mr. ELLIS, of the Greenwich Observatory, drew attention to some photographic records of the magnetic storm which occurred on the 31st of January. Earth current observations were taken on two wires, one running from the Observatory to Anglesea Wharf, and the other running to Blackheath Tunnel. The currents commenced at about three o'clock and continued till eight, and occurred again at one a.m. the next day. The magnetic observations accorded exactly with the electrical, as is always the case without exception. On January 13th, which was a quiet day, there were no magnetic disturbances, and on that day the earth current intensity showed a straight line. The results of thirty years' observations proved that the disturbances were coincident in time with the appearance of the sun spots. It was noticed that the electrical condition of the earth's surface was not affected by the magnetic storm. The magnetic observations were threefold—viz., for declination, for horizontal, and for vertical force. These were affected in different ways—the declination varied 1 to 8, equivalent to 9″ of arc. The age of the moon did not vary the changes.

Mr. C. F. VARLEY said that it would be interesting if exact figures could be given of Mr. Adams' observations, so that they could be compared with the Astronomer Royal's results. In 1859 he pointed out that it would not do to take the results obtained with land lines as proving anything definite, as in certain cases he found that the currents on two lines running north and south gave currents in one direction, whilst a wire between the two also running north and south showed a current in the reverse direction. This was due to the neutral potential line running in a circle. These lines were nearly perpendicular to the coast, owing to the sea conducting better than the earth. The only trustworthy way to obtain correct results would be on cables between islands. It has been noticed that the sun caused neap and spring tides, and very probably it also caused a similar electric tide. With reference to the cause of the currents, he considered it probable that the action of the sun on the atmosphere caused a change in the distribution of the electric potential, and therefore a current to be produced.

Mr. S. M. BANKER was of opinion that the electric tides were purely due to solar influence, as the periodic changes closely coincided with the solar changes, and it was difficult to explain why there should be a lagging behind in the change of the currents with the changes of the moon if the effect was due to lunar influence. The action of the sun on oxygen was powerful, and this gas being in the air, and a magnetic body, the changes in its distribution could produce the effects noticed. It has been observed by him that on the London-Cork circuit the instruments worked well from 10 to 11.30 a.m., and that there was then a difficulty up to 2 p.m., when good working could be resumed.

Mr. WILLOUGHBY SMITH stated that he had made experiments with two cables laid across the Thames, the further ends being sealed up and the nearer ends put to earth through galvanometers; no currents could be perceived. The results of observations he had made on several cables tended rather to confuse than to throw light upon the subject. He stated, as a curious fact, that on a good Atlantic cable, he had received a current at one end equal to 100 volts electromotive force, when there was no trace of current at the other end; on this occasion the sea was rough at one end and smooth at the other.

Mr. WOLLASTON pointed out that Mr. Smith's observations with the Thames cables were useless, as the latter, being sealed at the ends, there was no circuit, and therefore no currents could possibly be produced. In reply to Mr. Graves, who stated that the London-Cardiff wire, on which Mr. Adams' observations were made had no submarine cable in its length, Mr. Wollaston said that the earth current effect, which he attributed to the tide in the river Severn, would equally affect wires spanning over the river.

MR. C. E. SPAGNOLETTI gave the results of some observations on currents made during the storm of the 31st January which tended to confirm Mr. Varley's statement with reference to the neutral line running in a circle.

In answer to SIR CHARLES BRIGHT, PROFESSOR AYRTON explained that the action of a running river would be to induce currents in itself, part of which would complete their circuit through any wire which was in the neighbourhood, and this current would be continuous.

MR. G. K. WINTER said that, the results of observations made by him showed that there was a diurnal variation in the earth currents. He attributed the magnetometer effects to currents flowing through the earth, since a small magnetic needle was more powerfully affected than a large one, which would not be the case if the deviations were due to magnetic effect alone.

After some further observations from PROFESSOR AYRTON the meeting adjourned.

Correspondence.

SEYMOUR'S BALANCE GALVANOMETER.

To the Editor of THE TELEGRAPHIC JOURNAL.

SIR,—In your number of January 15th occurs an article on Seymour's Balance Galvanometer, in which we find the statement that "In the medical world we seldom see accounts of carefully-conducted electrical experiments with numerical values attached." To meet this want it is stated that Mr. Seymour's instrument has been devised. Allow us to state, in the first place, that we have now for more than a year been jointly charged with the management and administering of this powerful physiological agent at the hospital named below, and that we have from the first employed careful measurement in recognised electrical standards, by means of a modified Thomson's galvanometer and resistance coils specially adapted to the purpose. The instrument has been fully described by one of us in the "Hospital Reports," vol. x. As regards Mr. Seymour's proposed instrument, we are unable to understand why a deflection of a galvanometer "fails fully to meet the requirements of the electrician who desires to record as accurately as possible the account of his observations." Mr. Seymour proceeds to describe a galvanometer of his own devising which seems to possess no special advantages, whilst it has several inherent disadvantages, and which is neither so delicate in its action nor so simple in manipulation as the instrument above-named already placed before the public.

One very great objection to Mr. Seymour's instrument is that a new and perfectly arbitrary unit is introduced which has no physiological value, and which differs from those used by observers generally. This unit is a grain. Unless Mr. Seymour has omitted a very important part of his description the value of a grain varies with every instrument, and cannot under any circumstances be compared with the well-understood foot-grain-second unit. With the latter unit a current of 1 weber has a value of about ·07 grains, whilst with the instrument described it would be about 238 grains, and with a second instrument quite a different number. Consequently this galvanometer, instead of simplifying calculations, absolutely increases them.

The weights he uses are riders placed upon the beam of the instrument. They must necessarily be small and troublesome to adjust whilst administering the current to a patient, thus greatly deducting from the practical utility of the instrument.

Rapidity of action is frequently absolutely necessary for accuracy in testing the electric condition of the muscles, &c. The wording of the description implies that although possible it is difficult to weigh $\frac{1}{100}$ grain. Now this, with the instrument in question, has a value of 42 microwebers. It may be as well, by the way, to notice that Mr. Seymour has conducted all his experiments with Leclanché cells, whose E.M.F. he takes as 1·5, whereas they really have a very variable E.M.F., higher or lower according to the quality of the manganese used in their construction.

The formidable list of uses to which he applies his galvanometer only contains those in which galvanometers are ordinarily employed for the therapeutical administration of the galvanic current. He omits, perhaps from want of delicacy in his instrument and difficulty of manipulation, the important use of a galvanometer for diagnostic purposes, where accuracy and rapidity of action are positively essential.

Your obedient servants,
WILLIAM H. STONE, M.A., M.B., Oxon.
WALTER KILNA, M.A., M.B., Cantab.
Physician and Electrician to St. Thomas's Hospital

14, Dean's Yard, Westminster, S.W.
February 18th.

City Notes.

Old Broad Street, February 25, 1881.

SUBMARINE TELEGRAPH COMPANY.—The report of the directors submitted to the meeting held at the City Terminus Hotel on the 23rd inst. states that the gross receipts for the six months ending 31st December, 1880, amounted to £67,237 14s. 10½d., as shown in the annexed accounts; and on comparing this sum with the receipts for the six months ending 31st December, 1879, there will be found an increase of £5,924 17s. 8½d. This increase arises partly from the amount payable to the Company by the Paris and New York Telegraph Company, under the agreement referred to in the last report of the directors, but chiefly from the ordinary sources of traffic. In the half-year ending 31st December, 1879, the word rate was restricted to Germany and Holland, and 939,892 messages were transmitted, while in the corresponding period of the year 1880 the new tariff was applied to the correspondence of the whole of Europe, and the number of messages transmitted amounted to 1,370,977, showing an increase of 431,085 messages, and producing an additional revenue of £3,800 17s. 10½d. The directors have added 10 per cent. of the gross receipts, £5,592 19s. 5d., to the reserve fund, in lieu of 5 per cent., in accordance with the resolution passed at the last meeting of the proprietors; and the net result of the half-year's business enables the directors to recommend a dividend at the

rate of 19 per cent. per annum, and carry over a balance of £968 0s. 4d. The directors have taken possession of the Company's new offices in Throgmorton Avenue, and all the wires were successfully transferred from Threadneedle Street on the 15th January last, without the least interruption to the service. At the meeting the chairman, in moving the adoption of the report, said at the last meeting he had to state that there was a considerable increase of messages but a diminution in the receipts. He was happy to be able to state on the present occasion that there had been a considerable increase both in messages and receipts, which only proved that the word traffic had resulted in all they expected from it. It must be remembered that cables were cables, and liable to considerable wear and tear, and although they had not the liabilities attached to the deep sea cable system, yet in time their own must require renewal. A good reserve fund under such circumstances would become a matter of necessity, and he therefore hoped that they would not continue the 10 per cent. He was glad to be able to inform the shareholders that they had taken possession of their new premises. The transfer of the wires and the entire change had been carried out without the slightest disturbance of the system either in London or Paris. The directors felt that the time had arrived when it would be advisable to consider the propriety of instituting some sort of fund, which, in the case of sickness, old age, or death, would become a benefit to the staff who had served them so well. Mr. Ford (a shareholder) seconded the motion, which was carried, as was a resolution in favour of a fund, it being left to the directors to submit a scheme at a future meeting. A vote of thanks to the chairman, directors, and staff terminated the proceedings.

THE DIRECT UNITED STATES CABLE COMPANY, LIMITED.—The report of the directors for the six months ending 31st December, 1880, presented at the seventh ordinary general meeting held at the Cannon Street Hotel to-day, states that the revenue for the half-year, after deducting out-payments, amounted to £59,815 6s. 5d., as compared with £120,445 8s. 6d. (after similar deductions) for the corresponding period of 1879, being a difference of £60,630 2s. 1d. against the half-year under review; this difference being entirely due to the operation of the competitive tariffs in force during a portion of this period. The working and other expenses for the same period, including interest on debentures, and income tax, &c., amounted to £26,233 8s. 11d., leaving a balance of £33,581 17s. 6d. as the net profit for the half-year, making, with £21,760 8s. 10d. brought forward from the previous half-year, a total of £55,342 6s. 4d. For the corresponding half-year of 1879, the working expenses and other payments amounted to £25,001 3s. 6d. Interim dividends of 1¼ per cent. each for the quarters ending 30th September and 31st December, 1880, together amounting to £30,355, have been declared and paid. The sum of £21,870 8s. 9d. has been set aside to reserve fund (thereby increasing that fund to £200,000), and the balance of £3,116 17s. 7d. is carried forward. The £100,000 debenture loan has been received in full. An interruption occurred in the short section of the cable on Brown's Bank on the 23rd December, 1880, and was repaired on the 4th January, 1881. Another interruption occurred in the same section and in the same locality on the 18th January, 1881, and was repaired on the 27th January, 1881. These prompt repairs were effected by the s.s. *Minia*, under the command of Captain Trott, who reports that the breakage in each case had been caused by ship's anchors. The provisional agreements recently entered into between the Anglo-American Telegraph Company, the Direct United States Cable Company, and the Compagnie Frangaise du Télégraphe de Paris à New York, having for their object a division in agreed proportions of the traffic receipts of the three Companies, were approved at extraordinary general meetings of the proprietors of the three Companies, held in Paris and London on the 12th and 14th ultimo respectively.

TELEGRAPH CONSTRUCTION AND MAINTENANCE COMPANY, LIMITED.—From the report of the directors to be submitted to the shareholders at the meeting to be held on the 1st of March, it appears that the accounts for the year show a net profit of £98,673 10s. 10d. after charging the interest on the debentures. To this sum must be added £68,701 9s. 3d. brought forward from last year, making a total of £167,375 0s. 1d. From this amount is deducted the interim dividend of 5 per cent., paid July 20th, 1880, amounting to £22,410, leaving £144,965 0s. 1d. to be dealt with. Of this sum the directors propose to distribute a dividend of 15 per cent. or £67,230, being at the rate of £1 16s. per share, and making, with the amount already paid, a total dividend for the year of £2 8s. per share in cash, free of income tax, leaving £77,735 0s. 1d. to be carried forward to the next account. The operations carried out during the year 1880 have been as follows:—The Eastern Extension Telegraph Company's duplicate Australian Cable, alluded to in the last annual report, was finally completed in the month of January. A cable, 108 miles in length, connecting the Northern and Middle Islands of New Zealand, was laid for the New Zealand Government in the month of February. A cable between the Island of Luzon (Manilla), and Hong Kong, 299 miles in length (for which a concession was obtained from the Spanish Government in February, 1879), was completed in the month of April last, and has since been transferred to the Eastern Extension Telegraph Company. The deep sea portion of the Anglo-American Telegraph Company's Atlantic cable of 1866 has been renewed. This work was successfully carried out with the steam ships *Scotia* and *Seine* during the month of August. Subsequently a multiple cable, 209 miles in length, was laid for the same company between Newfoundland, St. Pierre, and Sydney, Cape Breton. In the month of September a cable was laid for the Great Northern Telegraph Company of Copenhagen, connecting Newbiggin, on the east coast of England, with Arendal, in Norway; and Arendal, with Marstand, on the coast of Sweden—the total length being 518 miles. Other lengths of cable have been made for various companies, bringing the total amount manufactured during the year to 3,453 miles. The erection of permanent stations for the Eastern and South African Telegraph Company's line, and the connection of the underground land lines with them, in accordance with the terms of the contract, are still in progress.

THE MEDITERRANEAN EXTENSION TELEGRAPH COMPANY, LIMITED. — The forty-seventh ordinary general meeting of the shareholders of the Mediterranean Extension Telegraph Company, Limited, was held yesterday, at the City Terminus Hotel, Cannon-street, E.C., Sir James Carmichael, Bart., the chairman of the Company, presiding. The report and accounts for the half-year ending December 31st last, showed a decrease in the traffic to the amount of £250, attributable in some degree to the operation of the word tariff, which had scarcely answered the expectations of the change from the previous rates. The amount to be claimed under the guarantee would, therefore, be proportionately heavier than

for the previous half-year. The Company's cables were in good order, and the cost of repairs and maintenance had been light. The directors proposed payment of the usual dividend, at the rate of 8 per cent. per annum, less income tax, on the preference stock of the Company, and of 3 per cent. per annum, free of income tax, on its ordinary stock, payable on and after the 7th proximo, leaving £462 to be carried to the reserve fund. The chairman said he thought he need hardly detain them with any remarks from himself. As they would have seen by the report, there was a slight falling off in the receipts, attributable to the operation of the word system, although there had been an increase in the number of messages, and since the date of the report there had been an increase in the receipts. They hoped next half-year to be able to report more favourably, and not to have to draw to such a large extent on the treasury. He concluded by moving the adoption of the report and accounts. The Hon. Ashley Ponsonby, a director, seconded the motion, which was carried, and the proposed dividend declared. The chairman, in reply to a shareholder, said the Government guarantee had to run two years longer. The usual vote of thanks was accorded to the chairman and directors.

THE INDIA-RUBBER, GUTTA-PERCHA, AND TELEGRAPH WORKS COMPANY last month despatched an expedition to lay submarine cables for the Mexican Telegraph Company between Brownsville in Texas and Vera Cruz in Mexico, with a station at Tampico, and news has been received by telegraph of the completion of the section from Brownsville to Tampico. These cables will place the telegraph system of Mexico in communication with those of the United States and Europe, and the Mexican Telegraph Company intend to carry a land line across the isthmus to Tehuantepec, and lay cables thence to Panama, under contracts already obtained with the Republics of Guatemala, Costa Rica, Nicaragua, and Columbia.

THE MONTREAL TELEGRAPH COMPANY.—The annual report of this Company gives a comparative statement of the gross revenue and expenditure for the last six years, which is as follows:—

	Revenue.	Expenditure.	Profit.
1875 ...	$550,493 34	$373,403 90	$177,089 44
1876 ...	508,919 25	357,356 24	151,563 01
1877 ...	514,122 26	345,450 83	168,671 43
1878 ...	485,302 46	343,204 84	142,097 95
1879 ...	478,435 32	335,573 86	142,861 46
1880 ...	550,840 01	358,676 08	192,163 93

From this it will be seen that the number of messages sent over the wires in 1880 was 388,071 in excess of 1879. This, of course, entailed a greater amount of expenditure, particularly in the matter of salaries, but this could not be avoided, and it is satisfactory to know that the large business of the Company has been done with great promptitude and correctness. The dividend paid in July last was 3 per cent., and that now payable 4 per cent.

INFORMATION has been received by the Cuba Submarine Telegraph Company of the successful laying of their new cable between Cienfuegos and Santiago de Cuba. This is the third cable which has been laid by the Company between these points, but as the 1870 one has ceased to work only two are now in operation.

THE EASTERN TELEGRAPH COMPANY advertise the repair of their Falmouth-Vigo cable, thus restoring telegraphic communication with Spain, Portugal, Gibraltar, Malta, and South America.

THE WESTERN AND BRAZILIAN TELEGRAPH COMPANY notify the repair of their Rio Grande do Sul, Monte Video, section, and that direct cable communication is now re-established between Europe, the Argentine Republic, and the West Coast of South America. This Company also announce that Sir Henry Drummond-Wolff, K.C.B., G.C.M.G., M.P., has accepted the chairmanship of the Company.

The following are the final quotations of telegraphs:—Anglo-American, Limited, 58¼-58⅜; Ditto, Preferred, 86⅜-87½; Ditto, Deferred, 30⅜-3¼; Black Sea, Limited, ——; Brazilian Submarine, Limited, 9⅞-10⅛; Cuba, Limited, 8⅞-9¼; Cuba, Limited, 10 per cent. Preference, 16¼-16¾; Direct Spanish, Limited, 3¼-3⅜; Direct Spanish, 10 per cent. Preference, 12⅜-13¼; Direct United States Cable, Limited, 1877, 10⅞-11⅛; Scrip of Debentures, 101-103; Eastern, Limited, 9⅞-9⅝; Eastern 6 per cent. Preference, 12¼-12½; Eastern, 6 per cent. Debentures, repayable October, 1883, 102-106; Eastern 5 per cent. Debentures, repayable August, 1887, 101-103; Eastern, 5 per cent., repayable Aug., 1899, 101-104; Eastern Extension, Australasian and China, Limited, 9⅞-10⅛; Eastern Extension, 6 per cent. Debenture, repayable February, 1891, 107-110; 5 per cent. Australian Gov. Subsidy Deb. Scrip, 1900, 104-106; Ditto, registered, repayable 1900, 104-106; Ditto, 5 per cent. Debenture, 1890, 102-104; Eastern and South African, Limited, 5 per cent. Mortgage Debentures, redeemable 1900, 101-103; Ditto, ditto, to bearer, 102-104; German Union Telegraph and Trust, 9⅞-10⅛; Globe Telegraph and Trust, Limited, 6⅛-6⅜; Globe, 6 per cent. Preference, 12-12½; Great Northern, 10⅞-11⅛; 5 per cent. Debentures, 102-105; Indo-European, Limited, 26½-27½; London Platino-Brazilian, Limited, 5⅛-5⅜; Mediterranean Extension, Limited, 2½-3; Mediterranean Extension, 8 per cent. Preference, 10⅛-10⅜; Reuter's Limited, 10⅞-11⅛; Submarine, 270-290; Submarine Scrip, 2⅛-2⅜; Submarine Cables Trust, 99-102; United Telephone Company, 3 pm.; West Coast of America, Limited, 4¼-4⅜; West India and Panama, Limited, 1⅛-1⅜; Ditto, 6 per cent. First Preference, 6-6½; Ditto, ditto, Second Preference, 5⅛-5⅜; Western and Brazilian, Limited, 7⅛-7⅜; Ditto, 6 per cent. Debentures "A," 103-107; Ditto, ditto, ditto, "B," 98-102; Western Union of U. S. 7 per cent., 1 Mortgage (Building) Bonds, 122-127; Ditto, 6 per cent. Sterling Bonds, 104-107; Telegraph Construction and Maintenance, Limited, 36-36½; Ditto, 6 per cent. Bonds, 105-108; Ditto, Second Bonus Trust Certificates, 3⅛-3⅜; India Rubber Company, 18½-19; Ditto, 6 per cent. Debenture, 107-109.

TRAFFIC RECEIPTS.

NAME OF COMPANY.	JANUARY.		INCREASE OR DECREASE.
	1881.	1880.	
	£	£	£
Anglo-American.....	*	...	...
Brazilian Submarine...	12,629	...	...
Cuba Submarine	2,800	3,406	Dec. 606
Direct Spanish	1,506	...	...
Direct United States...	*	...	...
Eastern	49,445	48,887	Inc. 558
Eastern Extension	29,491	28,009	Inc. 1,482
Great Northern	17,360	17,297	Inc. 63
Indo-European	...	...	...
Submarine	*	...	...
West Coast America ...	...	...	...
Western and Brazilian	8,567	9,153	Dec. 586
West India	...	...	...

* Publication suspended.